Claims

1. Apparatus for measuring deviation in the movement of a first body with respect to a second body comprising:

a transmitter unit mountable on the first body;

an optic unit mountable on the second body;

wherein the transmitter unit directs at least one light beam towards the optic unit;

wherein one of the transmitter unit and the optic unit is provided with two or more detectors to detect two or more light beams transmitted to or reflected from the optic unit,

wherein the optical arrangements for launch and detection of each light beam are substantially the same.

2. Apparatus according to claim 1 wherein a common equation may be used to determine different deviations.

3. Apparatus according to any preceding claim 1 wherein three light beams are transmitted to or reflected from the optic unit, such that deviation may be determined in five degrees of freedom.

4. Apparatus according to any preceding claim wherein the optic unit is provided with two or more optical elements each to reflect the respective two or more light beams towards the transmitter unit

5. Apparatus according to claim 4 wherein the two or more optical elements comprise three retroreflectors.

6. Apparatus according to claim 5 wherein two of the

retroreflectors are positioned side-by-side in the optic unit and the third retroreflector is positioned behind one of the first and second retroreflectors.

7. Apparatus according to claim 6 wherein the third retroreflector is positioned conceptually behind one of the first and second retroreflectors.

8. Apparatus according to any preceding claim wherein the two or more detectors comprise pixelated image sensors.

9. Apparatus according to any preceding claim wherein the two or more light beams remain substantially parallel throughout the system.

10. Apparatus according to any preceding claim wherein the two or more light beams remain substantially collimated throughout the system.

11. Apparatus according to any preceding claim wherein the at least one light source is produced from an incoherent light source and wherein a linear displacement measuring device is provided to measure the distance of the optic unit from the transmitter unit, the linear displacement measuring device having a coherent light source.

12. Apparatus according to any preceding claim wherein the light beams are transmitted from at least one coherent light source and wherein the light beams are intensity modulated to reduce their coherence length.

13. Apparatus according to claim 12 wherein the light

beams are intensity modulated to cause frequency variation which reduces the coherence pattern of the detected beams.

14. Apparatus according to claim 13 wherein the light beams are intensity modulated by turning the at least one light source on and off.

15. Apparatus according to any preceding claim wherein a light source is provided to produce the at least one beam and wherein an optical fibre separates the light source from the start of the projected light beam.

16. Apparatus according to any preceding claim wherein at least one optical element within the system is mounted on a bar to reduce movement of the optical element due to expansion.

17. Apparatus according to claim 16 wherein the bar is cooled to minimise expansion of the bar and thus minimise movement of the at least one optical element mounted on the bar.

18. Apparatus for measuring deviation in the relative movement between a first body and a second body, the apparatus comprising:

a transmitter unit mountable on the first body and an optic unit mountable on the second body;

the transmitter unit being provided with one or more detectors and wherein the transmitter unit directs at least one light beam towards the optic unit;

the optic unit being provided with three retroreflectors to reflect three beams of light towards the transmitter unit;

wherein the position of the three reflected light beams on the one or more detectors is used to determine the deviation of the trajectory from a straight line in five degrees of freedom.

19. Apparatus according to claim 18 wherein optical elements are provided in the optic unit to split the at least one light beam into three beams of light.

20. Apparatus according to claim 18 wherein the at least one light beam comprises three light beams.

21. Apparatus according to claim 18 wherein the one or more detectors comprises three detectors.

22. Apparatus for measuring squareness of the axes of a machine having first and second parts movable relative to one another, the apparatus comprising:

a base unit mountable on the first machine part;

a transmitter unit mountable on the base unit, the base unit and at least one surface of the transmitter unit being provided with cooperating elements to define the position of the transmitter unit relative to the base unit in a plurality of known relative orientations of the transmitter unit and thereby define the directions of at least one light beam;

an optic unit mounted on the second machine part;

wherein the transmitter unit directs at least one light beam towards the optic unit;

wherein one of the transmitter unit and the optic unit is provided with one or more detectors to detect one or more light beams transmitted to or reflected from the optic unit;

such that by orientating the transmitter unit

along two axes of the base unit and measuring the deviation of the at least one light beam on the at least one detector, the squareness of those two axes can be determined.

23. Apparatus for measuring deviation in the movement of a first body with respect to a second body comprising:

a transmitter unit mountable on the first body;

an optic unit mountable on the second body;

wherein the transmitter unit directs at least one light beam towards the optic unit;

wherein one of the transmitter unit and the optic unit is provided with one or more detectors to detect one or more light beams transmitted to or reflected from the optic unit;

wherein the position of the light beam on the detector is used as feedback to adjust the position of the transmitter unit or change the movement vector of the second body in order to maintain the light beam on the detector during relative movement of the first and second bodies.

24. Apparatus according to claim 23 wherein the position of the transmitter unit or the movement vector of the second body is adjusted in order to keep the light beam on substantially the same position on the detector.

25. Apparatus according to any of claims 23 or 24 wherein the transmitter unit is mounted on an adjustable base unit which is mounted on the first body and wherein the position of the transmitter unit is adjusted by adjusting the adjustable base unit.